SYNOPSIS FOR Ph.D. THESIS WORK

IN

AGRICULTURAL EXTENSION

TOPIC OF THE STUDY: Diversified Farming Systems in Northern Region of West Bengal: An Empirical Study

NAME OF THE RESEARCH SCHOLAR: Aditya Lama
Ph.D. Scholar
Department of Agricultural Extension
Palli Siksha Bhavana
Visva-Bharati

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INTRODUCTION

In the changing global scenario, threats to global food security in the most of agricultural regions of world are increasing with depleting natural resource base and due to changing climate (IPCC, 2007). In India where 80% of the total farmers are small and marginal. At least for these farmers, agriculture shall be an integrated system of cropping and livestock. Tree cropping is for green manure, fodder, food, fiber, fuel and timber. Livestock should include a variety of animals like cow or buffaloes, sheep or goats, chicken or pigs which feed on farm wastes like grasses, hay and the like, pruned branches from trees and weeds, broken and immature grains, spoiled fruits etc and produce milk, eat, eggs, money etc and valuable manure. Trees not only provide fodder, green manure etc., but also add enormous amount of biomass to soil, host beneficial predating insects and birds, conserve moisture from hot winds, conserve water from the soil, enrich the soil fertility by accommodating trillions of micro-organisms around their lengthy root systems and of course, income. Animals feeding on the farm waste, keep weeds under control with proper grazing and provide valuable manure on the farm. Their excreta shall be used as raw material for gobar gas plant producing cooking and lighting gas with value added manure for crops. Out of total 129.22 million land holders in the country, 64.8% are marginal holders who own less than 1 ha and 18.5 % families are small farmers owing between 1-2 hectares of land. Under the gradual shrinking of land holding, it is necessary to integrate land-based enterprises like fishery, poultry, duckery, apiary, field and horticultural crops, etc. within the bio-physical and socio-economic environment of the farmers to make farming more profitable and dependable. Integration of various farm enterprises in the form of Diversified Farming System (DFS) may offer sustainable solutions to these problems, especially for the increasing number of small holders in the region.

DFS is a mix of farm enterprises in which farm families allocate resources for efficient utilization of the existing enterprises for enhancing productivity and profitability of the farm. These farm enterprises are crop, livestock, aquaculture, agro-forestry, agri-horticulture and sericulture. In such diversified farming, though crop and other enterprises coexist. The high population growth, degradation of natural resources and climate change that would lead to food and nutritional insecurity jeopardizing in particular the livelihood of future generations. DFS as farming practices and landscapes that intentionally include functional biodiversity at multiple spatial and/or temporal scales in order to maintain ecosystem services that provide critical inputs to agriculture, such as soil fertility, pest and disease control, water use efficiency, and pollination (Kremen *et al.,* 2012).

DFS, therefore assumes greater importance for sound management of farm resources to enhance the farm productivity and reduce the environmental degradation, improve the quality of life of resource poor farmers and maintain sustainability. In order to sustain a positive growth rate in agriculture, a holistic approach is the need of the hour.

West Bengal is the most fast diversifying state in India, with more than 65% of the population engaged in agriculture & allied sectors is primarily an agrarian state. It is one among the most important agricultural states in India. Among the farmers more than 90% are poor, small and marginal. The state has been diversifying at a faster rate than the all India level. It is the sixth largest contributor to the country's GDP, which is attributed to agriculture and the allied sector. Its portion of agricultural land is amongst the highest of all Indian states (Economic Survey of India 2011-12). The state is divided into six agro-climatic zones (hilly region, terai region, old alluvial region, new alluvial region, coastal region and western laterite region), which brings considerable diversity in its agricultural activities. The agricultural sector of the state is characterized by the predominance of numerous small and marginal farmers tilling major portion of the total operated area of the state. The average size of land holding here is less than one hectare. Since the scope for bringing more area under cultivation is very limited, so greater emphasis has been laid mainly on increasing the productivity of different crops. Considering the fact that cropping diversity can reduce several limitations and risks involved in traditional methods of agriculture, it cannot eliminate the risk completely. It is difficult for the small and marginal farmers to get sufficient balanced food and income for their sustenance from crops alone. Hence, they ought to have other enterprises to supplement their farm income, employment and other farm/home requirements. It is essential to assess the economic viability of existing farming systems, their components and relationship between different enterprises within the system to improve the farming system efficiency (Kumaran & Vasanthakumar, 2010).

The sub himalayan regions falls in northern part of West Bengal comprises of the districts that are located at the north of the Ganga - Darjeeling, Jalpaiguri, Cooch Behar, Malda, Uttar Dinajpur, Dakshin Dinajpur, Alipurduar and Kalimpong - are often referred to collectively as North Bengal. Geographically, this area is divided into the Darjeeling Himalayan hill region, the Terai and Dooars region, and the North Bengal plains. The Siliguri Corridor, also known as Chicken's Neck, which connects North-East India with rest of the India, lies in this region. The Indo-Bangladesh enclaves are either enclaves or exclaves of the Cooch Behar district or the Jalpaiguri district. Agricultural activities are dominated mainly by small and marginal farmers (95%) with average size of holding being 0.44 ha (Som, 2005). Relatively high rate of illiteracy, higher concentration of SC/ST population, small size of holding and poor resource bases are the characteristic feature of this region. Despite of having natural

advantages in the production of good number of fruits, vegetables, flowers, some of the food grain crops, oilseeds and pulses, the farmers are mostly inclined to retain their traditional cropping pattern due to unique socio-economic conditions in hilly and terai/dooars region (Mohit Subba *et al.*, 2015). Farming systems in northern regions of West Bengal is heavily diversifying towards vegetable based farming system followed by dairy and plantation based systems, marginal and small farmers' dominant in hill zone has adopted diversified farming system apart from growing traditional cereal crops and the terai zone is dominated by conventional cereal-based farming systems, followed by vegetable based sub-system, and jute based systems with its vast agricultural field and forest area coverage, and very limited studies have been carried out in the region (Ray *et al.,* 2012).

Hence the present attempt is envisaging studying "Diversified Farming ystems in northern region of West Bengal: An empirical study" with the following objectives.

1. To study differential socio-economic profile of the farmers practizing different types of farming.
2. To explore the different types of diversified farming systems in northern region of West Bengal.
3. To study the level of awareness and adoption of diversified farming systems.
4. To ascertain the impact of agricultural diversification on farm output and farmers' livelihood.
5. To examine the advantages and limitations in practising diversified farming.

IMPORTANCE OF THE STUDY

The growth rate of agriculture in the recent past is very slow inspite of the rapid economic growth in India. **According to the Economic Survey of India, 2008**, the growth rate of food grain production decelerated to 1.2% during 1990-2007, lower than the population growth of 1.9%. It is projected that in our country population will touch 1370 million by 2030 and to 1600 million by 2050. To meet the demand, we have to produce 289 and 349 mt of food grains during the respective periods. The current scenario in the country indicates that area under cultivation may further dwindle and more than 20% of current cultivable area will be converted for non-agricultural purposes by 2030. The operational farm holding in India is declining and over 85 million out of 105 million are below the size of 1 ha. Due to ever increasing population and decline in per capita availability of land in the country, practically there is no scope for horizontal expansion of land for agriculture. Only vertical expansion is possible by integrating farming components requiring lesser space and time and ensuring reasonable returns to farm families. DFS depends on the willingness and capacity of farmers

to diversify their farms, but they need support and incentives to help survive the risks of changing from conventional to alternative production practices and to work together more collaboratively at the landscape level (Iles & Marsh 2012).

Cropping systems approach of agricultural research provided important findings to address the burning issues of sustainability and resource use efficiency in crop production. Still a need for integration of other enterprises is necessary to make more efficient use of available resources to reduce the gap between the desired and achieved and to improve the national food security (Tripathy & Manjunath, 2014). The latest available data shows that still about 66 percent of the country's labour force is engaged in agriculture and share only 32 percent of GDP. Conversely, 34 percent of the labour force being in the non-agricultural sector share about 68 percent of GDP. The average size of holdings of small and marginal farmers in India is so low that it cannot generate adequate employment and income for their sustenance, based on crop cultivation only. This is particularly true if the farmers use only traditional technology having local, low yielding plant varieties and low value subsistence crops and if they do not undertake other farm and non-farm activities including horticulture, sericulture, animal husbandry, fishing, agro-forestry, agro-processing, agro-services etc. Such glaring income disparities between agricultural and non-agricultural households must be removed through appropriate policy changes for horizontal as well as vertical diversification in rural areas (Haque, 2010).

Thus, for the purpose of national food security, price/income stability and protection of bio-diversity, there is need for maintaining a tender balance between those farming activities which are potentially more profitable and those which are relatively less profitable, but eco friendly. On the whole, it is generally agreed that diversified farming systems if adopted in a planned manner may lead to greater individual as well as social gains. It is in the interest of both individual small farmers and the nation as a whole to plan for horizontal diversification within agriculture as well as vertical diversification, involving income earning activities by small farms outside agriculture. This is intended not only to liberate the small and marginal farmers from the poverty trap, but also to meet the country's growing demands for fruits, vegetables, milk and milk products, meat, fish, eggs etc.

The study will also guide future researchers in understanding many aspects relevant to differential socio-economic profile of the farmers practicing different types of farming. Also, it will provide a full insight into the impact of agriculture diversification in farm output and farmers livelihood, level of awareness/adoption of DFS, level of satisfaction of farmers along with the factors associated with and the advantages/limitation faced by the farmers in obtaining diversified farming. Moreover, the study will assume great significance in creating

database for realistic planning and implementation of future diversified farming systems approach. Findings will also serve as a bench mark for future DFS approach.

2 REVIEW OF LITERATURE:

Zhang *et al*.,(2007) findings of the study had referred farming system as "diversified" when it intentionally includes functional biodiversity at multiple spatial and/or temporal scales, through practices developed via traditional and/or agro ecological scientific knowledge.

Om *et al*., (2008) study had highlighted that the concept of diversification remains incomplete and subdued if it is not supported by the diversified farming systems.

Torane *et al*., (2011) findings had revealed that out of the total farming systems in the study area, 52% have been found as the diversified farming systems. Also, the area which is nearer to the sea coast has shown higher diversification than the area away from the sea coast.

Kremen *et al*., (2012) findings had explored to what extent diversified farming systems (DFS) overlap or are differentiated from existing concepts such as sustainable, multi functional, organic or eco agriculture.

Iles and Marsh (2012) findings of the study had concluded diversified farming systems depends on the willingness and capacity of farmers to diversify their farms, but they need support and incentives to help survive the risks of changing from conventional to alternative production practices and to work together more collaboratively at the landscape level.

Khatun and Roy (2012) in their study conducted in the state of West Bengal had shown that household-head experience(age), educational level, social status, training, asset position, access to credit, rural infrastructure, agro climatic condition and the overall level of economic development of a region are the main driving force towards livelihood diversification in the state.

Bacon *et al*., (2012) findings of the study had illustrated that diversified farming system are interdependent with a set of institutional environments that specifically promote diversified farming practices and that enhance the social benefits of sustainable agriculture.

Bowman and Zilberman (2013) research findings had concluded that the expansion and adoption of DFS is limited by a number of factors, including still-limited demand for products produced via DFS, supply-side constraints such as high costs of tilling or harvest in multiple crop systems, and policies such as subsidies and crop insurance which discourage diversification.

Goswami *et al.*, (2014) in their study of research findings had identified four major types of farms, based on the source from which maximum gross income was earned by the farmers. Those were – rice-based farming system (34 households), vegetable - based farming system (70 households), fishery - based farming system (10 households) and farming system based on off - farm income (20 households).

Tripathya and Manjunath (2014) investigation of the study had identified the existing farming systems in 12 major states of India at district level using remote sensing and ancillary data, delineated 44 farming systems with the help of GIS it became possible for integrating different enterprises (Agriculture, Livestock, Poultry and inland fish production)

Chatterjee *et al*., (2015) had identified four distinct farm types, namely, farms growing food grain and jute, farms with animal husbandry and fishery based diversification with high off-farm income, farms with crop based diversification with off-farm income, and farms growing vegetables and fruits and also concluded that farm type identification and characterization based on estimates of income from different farm components allows simplifying diversity in farming systems.

RESEARCH SETTING

Locale of the study:

3. RESEARCH METHODOLOGY

The details of the research methods are explained and presented under the following heads:

3.1. Sampling procedure

3.2. Selection of variables and their measurement

3.3. Techniques of Data Collection

3.4. Data analysis

3.1 Sampling Procedure:

The northern region of West Bengal will be purposively select i.e. hilly and terai regions of the state, as the major area of these regions represents different types of agro climatic, farming systems and socio economic livelihood conditions respectively. The selection of the district, block and villages will be based on stratified random sampling. And in case of selection of respondent's, twenty farmers representing different categories from each village covering to a total sample of 320 respondents will be taken up through simple random technique. The equality in the sample from both regions will made in order to create a suitable base for comparison process.

State	Districts	RD blocks	Villages	Respondents	Total sample size	Sampling procedure
West Bengal	D1	B1	2	40	320	Stratified random sampling
		B2	2	40		
	D2	B1	2	40		
		B2	2	40		
	D3	B1	2	40		
		B2	2	40		
	D4	B1	2	40		
		B2	2	40		

3.2 Variables and their measurements:

The variables will be selected based on the objectives of present study. A brief detail of the variables considered in present study and their measurement procedures is given below.

Variables		Measurement
Socio-personal		
1	Age	On the basis of chronological age at the time of investigation
2	Sex	Categorized as male and female
3	Education level	Scale developed by Pareek and Trivedi (1964)
4	Family size	Scale developed by Pareek and Trivedi (1964)
5	Occupation	Structured schedule will be developed
Socio -economic		
1	Size of land holdings	Structured schedule will be developed
2	Leased in land	Structured schedule will be developed
3	Leased out land	Structured schedule will be developed
4	Fragmented land	Structured schedule will be developed

5	Indebtedness	Structured schedule will be developed
6	Annual yield	Structured schedule will be developed
7	Cropping intensity	Structured schedule will be developed
8	Farm resource available	Structured schedule will be developed
9	Farming practices	Structured schedule will be developed
10	Farm types	Structured schedule will be developed
11	Irrigation status	Structured schedule will be developed
12	Annual income, income from agriculture/farming	Structured schedule will be developed
13	Communicational profile	Scale developed by Singh (1972)
Socio- psychological		
1	Economic motivation	Scale developed by Maulik (1965)
2	Innovation Proneness	Scale developed by Maulik & Rao (1965)
3	Independency	Scale developed by Supe (1969)
4	Risk orientation	Structured schedule will be developed

Variables		**Measurement**
1	Different components of diversified farming systems	Structured schedule will be developed
2	Level of awareness/adoption	Scale developed by Segnon *et al.*, 2015
3	Level of impact on livelihood status (human, social, physical and financial)	Scale developed by Department of International Development (1999)
4.	Level of impact on farm output	Structured schedule will be developed
5.	Advantages/Constraints associated with Diversified Farming Systems	Structured schedule will be developed

3.3 Techniques of data collection:

A pilot study will be conducted among some of the respondents from non-sampling areas to check the reliability of the schedule. Based on the information received in the pilot study, the schedule will be modified and finalized to conduct the survey.

Primary data will be collected directly from the sampled respondents with the help of interview schedules through personal interview. Secondary data will be collected from published sources and relevant Government departments and other reliable sources.

3.4 Statistical tools and analysis:

Data collected for the study will be arranged, coded and analyzed through the use of Statistical Package for the Social Sciences (SPSS) computer programme. Both descriptive and inferential statistical tools will be utilized to analyze the data.

Both descriptive and inferential statistical tools will utilize to analyze the data.

a. Descriptive statistical tools will be used are 1) frequency counts, 2) percentages 3) mean 4) Standard Deviation and coefficient of variations.

b. Inferential statistical tools will be used as: 1) Spearman correlation, 2) Regression Analysis.

c. Tests of significance will be employed as per the objectives of the study

IMPLICATION OF THE STUDY

The implications of the study may be illustrated in practical and academic terms. While the practical focus is on institutional arrangement and policy interventions, the focus has been on methodological insights gained and its possible up scaling. The results of the study shall make a profound implications in redefining research and extension strategies towards a livelihood diversified farming systems approach to rural development. Identification and characterization of farming systems simplify huge diversity of farm types in complex agro-ecosystems, which is of critical importance for precise technological intervention and informed policy support.

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